NIH NATIONAL CANCER INSTITUTE

Cancer Prevention Overview (PDQ®)–Patient Version

Go to Health Professional Version

What Is Prevention?

Cancer prevention is action taken to lower the chance of getting cancer. In 2023, about 1.9 million people will be diagnosed with cancer in the United States. In addition to the physical problems and emotional distress caused by cancer, the high costs of care are also a burden to patients, their families, and to the public. By preventing cancer, the number of new cases of cancer is lowered. Hopefully, this will reduce the burden of cancer and lower the number of deaths caused by cancer.

Cancer is not a single disease but a group of related diseases. Many things in our genes, our lifestyle, and the environment around us may increase or decrease our risk of getting cance

Scientists are studying many different ways to help prevent cancer, including the following:

- Ways to avoid or control things known to cause cancer.
- Changes in diet and lifestyle.
- Finding precancerous conditions early. Precancerous conditions are conditions that may become cancer.
- Chemoprevention (medicines to treat a precancerous condition or to keep cancer from starting).
- Risk-reducing surgery.

Carcinogenesis

KEY POINTS

- Carcinogenesis is the process in which normal cells turn into cancer cells.
- Changes (mutations) in genes occur during carcinogenesis.

Carcinogenesis is the process in which normal cells turn into cancer cells.

Carcinogenesis is the series of steps that take place as a normal cell becomes a cancer cell. Cells are the smallest units of the body and they make up the body's tissues. Each cell contains genes that guide the way the body grows, develops, and repairs itself. There are many genes that control whether a cell lives or dies, divides (multiplies), or takes on special functions, such as becoming a nerve cell or a muscle cell.

Changes (mutations) in genes occur during carcinogenesis.

Changes (mutations) in genes can cause normal controls in cells to break down. When this happens, cells do not die when they should and new cells are produced when the body does not need them. The buildup of extra cells may cause a mass (tumor) to form.

Tumors can be benign or malignant (cancerous). Malignant tumor cells invade nearby tissues and spread to other parts of the body. Benign tumor cells do not invade nearby tissues or spread.

Risk Factors

KEY POINTS

- Factors that are known to increase the risk of cancer
  - Cigarette smoking and tobacco use
  - Infections
  - Radiation
  - Immunosuppressive medicines after organ transplant
- Factors that may affect the risk of cancer
  - Diet
  - Alcohol
  - Physical activity
  - Obesity
  - Diabetes
  - Environmental risk factors

Scientists study risk factors and protective factors to find ways to prevent new cancers from starting. Anything that increases your chance of developing cancer is called a cancer risk factor; anything that decreases your chance of developing cancer is called a cancer protective factor.

Some risk factors for cancer can be avoided, but many cannot. For example, both smoking and inheriting certain genes are risk factors for some types of cancer, but only smoking can be avoided. Risk factors that a person can control are called modifiable risk factors.

Many other factors in our environment, diet, and lifestyle may cause or prevent cancer. This summary reviews only the major cancer risk factors and protective factors that can be controlled or changed to reduce the risk of cancer. Risk factors that are not described in the summary include certain sexual behaviors, the use of estrogen, and being exposed to certain substances at work or to certain chemicals.

Factors that are known to increase the risk of cancer

Cigarette smoking and tobacco use

Tobacco use is strongly linked to an increased risk for many kinds of cancer. Smoking cigarettes is the leading cause of the following types of cancer:

- Acute myelogenous leukemia (AML).
- Bladder cancer.
- Cervical cancer.
- Esophageal cancer.
- Kidney cancer.
- Lung cancer.
- Oral cavity cancer.
- Pancreatic cancer.
- Stomach cancer.

Not smoking or quitting smoking lowers the risk of getting cancer and dying from cancer. Scientists believe that cigarette smoking causes about 30% of all cancer deaths in the United States.

See the following PDQ summaries for more information:

- Lung Cancer Prevention
- Lung Cancer Screening

- Cigarette Smoking: Health Risks and How to Quit

Infections

Certain viruses and bacteria are able to cause cancer. Examples of cancer-causing viruses and bacteria include:

- Human papillomavirus (HPV) increases the risk for cancers of the cervix, penis, vagina, anus, and oropharynx.
- Hepatitis B and hepatitis C viruses increase the risk for liver cancer.
- Epstein-Barr virus increases the risk for Burkitt lymphoma.
- *Helicobacter pylori* increases the risk for gastric cancer.

Two vaccines to prevent infection by cancer-causing agents have been developed and approved by the US Food and Drug Administration (FDA). One is a vaccine to prevent infection with hepatitis B virus. The other protects against infection with strains of human papillomavirus (HPV) that cause cervical cancer. Scientists continue to work on vaccines against infections that cause cancer.

See the following PDQ summaries for more information:

- Cervical Cancer Causes, Risk Factors, and Prevention
- Cervical Cancer Screening
- Liver Cancer Causes, Risk Factors, and Prevention
- Stomach Cancer Causes and Risk Factors
- Oral Cavity, Oropharyngeal, Hypopharyngeal, and Laryngeal Cancers Prevention

Radiation

Being exposed to radiation is a known cause of cancer. There are two main types of radiation linked with an increased risk of cancer:

- Ultraviolet radiation from sunlight: This is the main cause of nonmelanoma skin cancers.
- Ionizing radiation including:
  - Medical radiation from tests to diagnose cancer such as x-rays, CT scans, fluoroscopy, and nuclear medicine scans.
  - Radon gas in our homes.

Scientists believe that ionizing radiation causes leukemia, thyroid cancer, and breast cancer in women. Ionizing radiation may also be linked to myeloma and cancers of the lung, stomach,

colon, esophagus, bladder, and ovary. Being exposed to radiation from diagnostic x-rays increases the risk of cancer in patients and x-ray technicians. Diagnostic radiation in children and adolescents has been linked with a higher risk of cancers at a young age.

The growing use of CT scans over the last 20 years has increased exposure to ionizing radiation. The risk of cancer also increases with the number of CT scans a patient has and the radiation dose used each time.

See the following PDQ summaries for more information:

- Breast Cancer Prevention
- Breast Cancer Screening
- Skin Cancer Prevention
- Lung Cancer Prevention

Immunosuppressive medicines after organ transplant

Immunosuppressive medicines are used after an organ has been transplanted from one person to another. These medicines stop an organ that has been transplanted from being rejected. These medicines decrease the body's immune response to help keep the organ from being rejected. Immunosuppressive medicines are linked to an increased risk of cancer because they lower the body's ability to keep cancer from forming. The risk of cancer, especially cancer caused by a virus, is higher in the first 6 months after organ transplant, but the risk lasts for many years.

Factors that may affect the risk of cancer

Diet

The foods that you eat on a regular basis make up your diet. Diet is being studied as a risk factor for cancer. It is hard to study the effects of diet on cancer because a person's diet includes foods that may protect against cancer and foods that may increase the risk of cancer.

It is also hard for people who take part in the studies to keep track of what they eat over a long period of time. This may explain why studies have different results about how diet affects the risk of cancer.

Some studies have shown that a diet high in fat, proteins, calories, and red meat increases the risk of colorectal cancer, but other studies have not shown this.

It is not known if a diet low in fat and high in fiber, fruits, and vegetables lowers the risk of colorectal cancer.

Alcohol

Studies have shown that drinking alcohol is linked to an increased risk of the following types of cancers:

- Oral cancer.
- Esophageal cancer.
- Breast cancer.
- Colorectal cancer (in men).

Drinking alcohol may also increase the risk of liver cancer and female colorectal cancer.

See the following PDQ summaries for more information:

- Breast Cancer Prevention
- Colorectal Cancer Prevention
- Lung Cancer Prevention
- Esophageal Cancer Prevention
- Oral Cavity, Oropharyngeal, Hypopharyngeal, and Laryngeal Cancers Prevention
- Liver Cancer Causes, Risk Factors, and Prevention

Physical activity

Studies show that people who are physically active have a lower risk of certain cancers than those who are not. It is not known if physical activity itself is the reason for this.

Some studies show that physical activity protects against postmenopausal breast cancer and endometrial cancer.

See the following PDQ summaries for more information:

- Breast Cancer Prevention
- Colorectal Cancer Prevention
- Endometrial Cancer Prevention

Obesity

Studies show that obesity is linked to a higher risk of the following types of cancer:

- Postmenopausal breast cancer.

- Colorectal cancer.
- Endometrial cancer.
- Esophageal cancer.
- Kidney cancer.
- Pancreatic cancer.

Some studies show that obesity is also a risk factor for cancer of the gallbladder and liver cancer.

Studies have shown that people who lose weight decrease their risk of these cancers.

See the following PDQ summaries for more information:

- Breast Cancer Prevention
- Colorectal Cancer Prevention
- Endometrial Cancer Prevention
- Lung Cancer Prevention

Diabetes

Some studies show that having diabetes may slightly increase the risk of having the following types of cancer:

- Bladder cancer.
- Breast cancer in women.
- Colorectal cancer.
- Endometrial cancer.
- Liver cancer.
- Lung cancer.
- Oral cancer.
- Oropharyngeal cancer.
- Ovarian cancer.
- Pancreatic cancer.

Diabetes and cancer share some of the same risk factors. These risk factors include the following:

- Being older.
- Having obesity.
- Smoking.
- Not eating a healthy diet.
- Not exercising.

Because diabetes and cancer share these risk factors, it is hard to know whether the risk of cancer is increased more by diabetes or by these risk factors.

Studies are being done to see how medicine that is used to treat diabetes affects cancer risk.

Environmental risk factors

Being exposed to chemicals and other substances in the environment has been linked to some cancers:

- Links between air pollution and cancer risk have been found. These include links between lung cancer and secondhand tobacco smoke, outdoor air pollution, and asbestos.
- Drinking water that contains a large amount of arsenic has been linked to skin, bladder, and lung cancers.

Studies have been done to see if pesticides and other pollutants increase the risk of cancer. The results of those studies have been unclear because other factors can change the results of the studies.

Interventions That Are Known to Lower Cancer Risk

KEY POINTS

- Chemoprevention is being studied in people who have a high risk of developing cancer.
- Studies have shown that weight loss surgery lowers cancer risk.

An intervention is a treatment or action taken to prevent or treat disease, or improve health in other ways. Many studies are being done to find ways to keep cancer from starting or coming back.

Chemoprevention is being studied in people who have a high risk of developing cancer.

Chemoprevention is the use of substances to lower the risk of cancer, or keep it from recurring. The substances may be natural or made in the laboratory. Some chemopreventive agents are tested in people who are at high risk for a certain type of cancer. The risk may be because of a precancerous condition, family history, or lifestyle factors.

Taking one of the following agents may lower the risk of cancer:

- Selective estrogen receptor modulators (SERMS) such as tamoxifen or raloxifene have been shown to reduce the risk of breast cancer in women at high risk. SERMS may cause side effects, such as hot flashes, so they are not often used for prevention of cancer. For more information, see Breast Cancer Prevention.
- Finasteride has been shown to lower the risk of prostate cancer. For more information, see Prostate Cancer Prevention.
- COX-2 inhibitors may prevent colon and breast cancer. COX-2 inhibitors may cause heart problems. Because COX-2 inhibitors may cause heart problems there have not been many studies on their use to prevent cancer. For more information, see Colorectal Cancer Prevention and Breast Cancer Prevention.

Studies have shown that weight loss surgery lowers cancer risk.

Weight loss surgery, also called bariatric surgery, is a procedure that people with obesity can have to lose weight and improve their overall health and quality of life. The surgery changes the anatomy of the stomach or changes the way the body absorbs nutrients. A person who undergoes this procedure will lose a lot of weight and as a result, will have a decreased risk of cancers that are linked to being overweight.

See the NCI website for more information about cancer prevention.

Interventions That Are Not Known to Lower Cancer Risk

KEY POINTS

- Aspirin has not been shown to prevent most cancers.
- Vitamin and dietary supplements have not been shown to prevent cancer.
- New ways to prevent cancer are being studied in clinical trials.

Aspirin has not been shown to prevent most cancers.

Aspirin has been studied as chemoprevention. The studies show mixed results but most have shown that aspirin does not prevent cancer. However, there is evidence that taking aspirin for long periods of time may prevent colorectal cancer in certain people. For more information, see Colorectal Cancer Prevention.

Results from a randomized trial suggest that taking aspirin may make cancer grow more quickly in the elderly, but longer follow up is needed to confirm these results.

Bleeding in the gastrointestinal tract or brain is a side effect of aspirin. Even though aspirin has not been shown to reduce the risk of most cancers, it has many uses, including helping to lower the chances of dying from heart disease. Before beginning long-term aspirin use, it is important to talk with your doctor about the related benefits and harms.

Vitamin and dietary supplements have not been shown to prevent cancer.

An intervention is a treatment or action taken to prevent or treat disease, or improve health in other ways.

There is not enough proof that taking multivitamin and mineral supplements or single vitamins or minerals can prevent cancer. The following vitamins and mineral supplements have been studied, but have not been shown to lower the risk of cancer:

- Vitamin B6.
- Vitamin B12.
- Vitamin E.
- Vitamin C.
- Beta carotene.
- Folic acid.
- Selenium.
- Vitamin D.

The Selenium and Vitamin E Cancer Prevention Trial (SELECT) found that vitamin E taken alone increased the risk of prostate cancer. The risk continued even after the men stopped taking vitamin E. Taking selenium with vitamin E or taking selenium alone did not increase the risk of prostate cancer.

Vitamin D has also been studied to see if it has anticancer effects. Skin exposed to sunshine can make vitamin D. Vitamin D can also be consumed in the diet and in dietary supplements.

Taking vitamin D in doses from 400–1100 IU/ day has not been shown to lower or increase the risk of cancer.

The VITamin D and OmegA-3 TriaL (VITAL) is under way to study whether taking vitamin D (2000 IU/ day) and omega-3 fatty acids from marine (oily fish) sources lowers the risk of cancer.

The Physicians' Health Study found that men who have had cancer in the past and take a multivitamin daily may have a slightly lower risk of having a second cancer.

See the following PDQ summaries for more information:

- Breast Cancer Prevention
- Colorectal Cancer Prevention
- Lung Cancer Prevention
- Prostate Cancer Prevention

New ways to prevent cancer are being studied in clinical trials.

Information about clinical trials supported by NCI can be found on NCI's clinical trials search webpage. Clinical trials supported by other organizations can be found on the ClinicalTrials.gov website.

About This PDQ Summary

About PDQ

Physician Data Query (PDQ) is the National Cancer Institute's (NCI's) comprehensive cancer information database. The PDQ database contains summaries of the latest published information on cancer prevention, detection, genetics, treatment, supportive care, and complementary and alternative medicine. Most summaries come in two versions. The health professional versions have detailed information written in technical language. The patient versions are written in easy-to-understand, nontechnical language. Both versions have cancer information that is accurate and up to date and most versions are also available in Spanish.

PDQ is a service of the NCI. The NCI is part of the National Institutes of Health (NIH). NIH is the federal government's center of biomedical research. The PDQ summaries are based on an independent review of the medical literature. They are not policy statements of the NCI or the NIH.

Purpose of This Summary

This PDQ cancer information summary has current information about cancer prevention. It is meant to inform and help patients, families, and caregivers. It does not give formal guidelines or recommendations for making decisions about health care.

Reviewers and Updates

Editorial Boards write the PDQ cancer information summaries and keep them up to date. These Boards are made up of experts in cancer treatment and other specialties related to cancer. The summaries are reviewed regularly and changes are made when there is new information. The date on each summary ("Updated") is the date of the most recent change.

The information in this patient summary was taken from the health professional version, which is reviewed regularly and updated as needed, by the PDQ Screening and Prevention Editorial Board.

Clinical Trial Information

A clinical trial is a study to answer a scientific question, such as whether one treatment is better than another. Trials are based on past studies and what has been learned in the laboratory. Each trial answers certain scientific questions in order to find new and better ways to help cancer patients. During treatment clinical trials, information is collected about the effects of a new treatment and how well it works. If a clinical trial shows that a new treatment is better than one currently being used, the new treatment may become "standard." Patients may want to think about taking part in a clinical trial. Some clinical trials are open only to patients who have not started treatment.

Clinical trials can be found online at NCI's website. For more information, call the Cancer Information Service (CIS), NCI's contact center, at 1-800-4-CANCER (1-800-422-6237).

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The information in these summaries should not be used to make decisions about insurance reimbursement. More information on insurance coverage is available on Cancer.gov on the Managing Cancer Care page.

Contact Us

More information about contacting us or receiving help with the Cancer.gov website can be found on our Contact Us for Help page. Questions can also be submitted to Cancer.gov through the website's E-mail Us.

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